

APPENDIX B

TABLE B.1. Correlation Between Benkelman Beam and Dynaflect Deflections

Utility Cut Description	Traffic	Test Point Location	Dynaflect Deflection (in.)	Benkelman Beam Deflection (in.)
UCASPCLIHUC-1	H	control	0.00043	0.012
		1' from edge	0.00047	0.017
		cut edge, pvmnt	0.00062	0.018
		cut edge, cut	0.00071	0.014
UCASP8TH304N-1	M	center of cut	0.00058	0.023
		control	0.00076	0.034
		1' from edge	0.00116	0.037
		cut edge, pvmnt	0.00123	0.051
UCASP8TH304S-1	M	cut edge, cut	0.00141	0.048
		center of cut	0.00119	0.037
		control	0.00078	0.028
		1' from edge	0.00079	0.029
UCMACBEK3411-1	H	cut edge, pvmnt	0.00087	0.024
		cut edge, cut	0.00116	0.030
		center of cut	0.00138	0.035
		control	0.00066	0.030
UCMACOBS2881-1	M	1' from edge	0.00067	0.027
		cut edge, pvmnt	0.00077	0.030
		cut edge, cut	0.00076	0.039
		center of cut	0.00097	0.039
UCMACMON3431-1	L	control	0.0010	0.024
		1' from edge	0.00118	0.028
		cut edge, pvmnt	0.00145	0.042
		cut edge, cut	0.00111	0.032
		center of cut	0.00136	0.021
		control	0.00216	0.111
		1' from edge	0.00243	0.130
		cut edge, pvmnt	0.00222	0.103
		cut edge, cut	0.00214	0.124
		center of cut	0.00133	0.033

TABLE B.2. Correlation Between Benkelman Beam and FWD-9 kip Deflections

Utility Cut Description	Traffic	Load (kips)	Test Point Location	FWD Deflection (in.)	Benkelman Beam Deflection (in.)
UCASPCLIHUC	H	9	cut edge, pvm _L	0.01284	0.018
			1' from edge	0.010755	0.017
			2' from edge	0.00807	0.013
			4' from edge	0.00678	0.011
			control	0.0093	0.012
UCASPLIN859	M	9	cut edge, pvm _L	0.0406704	0.143
			1' from edge	0.0353757	0.117
			2' from edge	0.0311688	0.091
			4' from edge	0.0348873	0.086
			control	0.0341991	0.087
UCASP8TH304S	M	9	cut edge, pvm _L	0.019815	0.024
			1' from edge	0.016428	0.029
			2' from edge	0.022065	0.036
			4' from edge	0.0187812	0.032
			control	0.02775	0.026
UCMACOBS2881	M	9	cut edge, pvm _L	0.02862	0.042
			1' from edge	0.02256	0.028
			2' from edge	0.019875	0.025
			4' from edge	0.018705	0.025
			control	0.02061	0.024
UCMACOBS3044	M	9	cut edge, pvm _L	0.02574	0.049
			1' from edge	0.0228	0.051
			2' from edge	0.020355	0.046
			4' from edge	0.01968	0.045
			control	0.02226	0.048
UCMACLAF402	M	9	cut edge, pvm _L	0.0334512	0.058
			1' from edge	0.0307008	0.062
			2' from edge	0.0278784	0.057
			4' from edge	0.0275328	0.051
			control	0.0122112	0.021
UCMACWTF3332	M	9	cut edge, pvm _L	0.0322272	0.033
			1' from edge	0.0308736	0.037
			2' from edge	0.0292896	0.039
			4' from edge	0.0327456	0.035
			control	0.0290016	0.032

TABLE B.2. (Contd)

Utility Cut Description	Traffic	Load (kips)	Test Point Location	FWD Deflection (in.)	Benkeiman Beam Deflection (in.)
UCASPPRK2324	L	9	cut edge, pvmnt. 1' from edge 2' from edge 4' from edge control	0.0244755 0.0266955 0.0252414 0.0222111 0.0181929	0.077 0.067 0.058 0.06 0.054
UCASPFFD3054	L	9	cut edge, pvmnt. 1' from edge 2' from edge 4' from edge control	0.0300587 0.0353073 0.0398958 0.041538 0.0324254	0.037 0.05 0.046 0.044 0.047
UCASPROC1005	L	9	cut edge, pvmnt. 1' from edge 2' from edge 4' from edge control	0.1038128 0.0875196 0.0865536 0.0782299 0.0803229	0.128 0.137 0.14 0.114 0.119
UCMACDUN3422	L	9	cut edge, pvmnt. 1' from edge 2' from edge 4' from edge control	0.086085 0.09006 0.089625 0.08022 0.081135	0.131 0.135 0.147 0.127 0.13
UCMACMON3431	L	9	cut edge, pvmnt. 1' from edge 2' from edge 4' from edge control	0.092265 0.10167 0.094515 0.08181 0.07392	0.103 0.13 0.112 0.114 0.111
UCMACMON3579	L	9	cut edge, pvmnt. 1' from edge 2' from edge 4' from edge control	0.057405 0.0582 0.052395 0.04818 0.055695	0.055 0.071 0.064 0.072 0.091

TABLE B.3. Correlation Between Benkelman Beam and FWD-12 kip Deflections

Utility Cut Description	Traffic	Load (kips)	Test Point Location	FWD Deflection (in.)	Benkelman Beam Deflection (in.)
UCASPCLIHUC	H	12	cut edge, pvmnt.	0.016875	0.018
			1' from edge	0.013995	0.017
			2' from edge	0.010635	0.013
			4' from edge	0.008985	0.011
			control	0.01266	0.012
UCASPLIN859	M	12	cut edge, pvmnt.	0.0542457	0.143
			1' from edge	0.0474636	0.117
			2' from edge	0.0418914	0.091
			4' from edge	0.047952	0.086
			control	0.0459207	0.087
UCASP8TH304S	M	12	cut edge, pvmnt.	0.025065	0.024
			1' from edge	0.02751	0.029
			2' from edge	0.027885	0.036
			4' from edge	0.031365	0.032
			control	0.034305	0.026
UCMACOBS2881	M	12	cut edge, pvmnt.	0.037485	0.042
			1' from edge	0.03027	0.028
			2' from edge	0.026775	0.025
			4' from edge	0.025245	0.025
			control	0.028005	0.024
UCMACOBS3044	M	12	cut edge, pvmnt.	0.03357	0.049
			1' from edge	0.03087	0.051
			2' from edge	0.02733	0.046
			4' from edge	0.026535	0.045
			control	0.03045	0.048
UCMACLAF402	M	12	cut edge, pvmnt.	0.0447264	0.058
			1' from edge	0.0411984	0.062
			2' from edge	0.0377424	0.057
			4' from edge	0.0372672	0.051
			control	0.0165456	0.021
UCMACWTF3332	M	12	cut edge, pvmnt.	0.04284	0.033
			1' from edge	0.04068	0.037
			2' from edge	0.0385056	0.039
			4' from edge	0.042552	0.035
			control	0.0383904	0.032

TABLE B.3. (Contd)

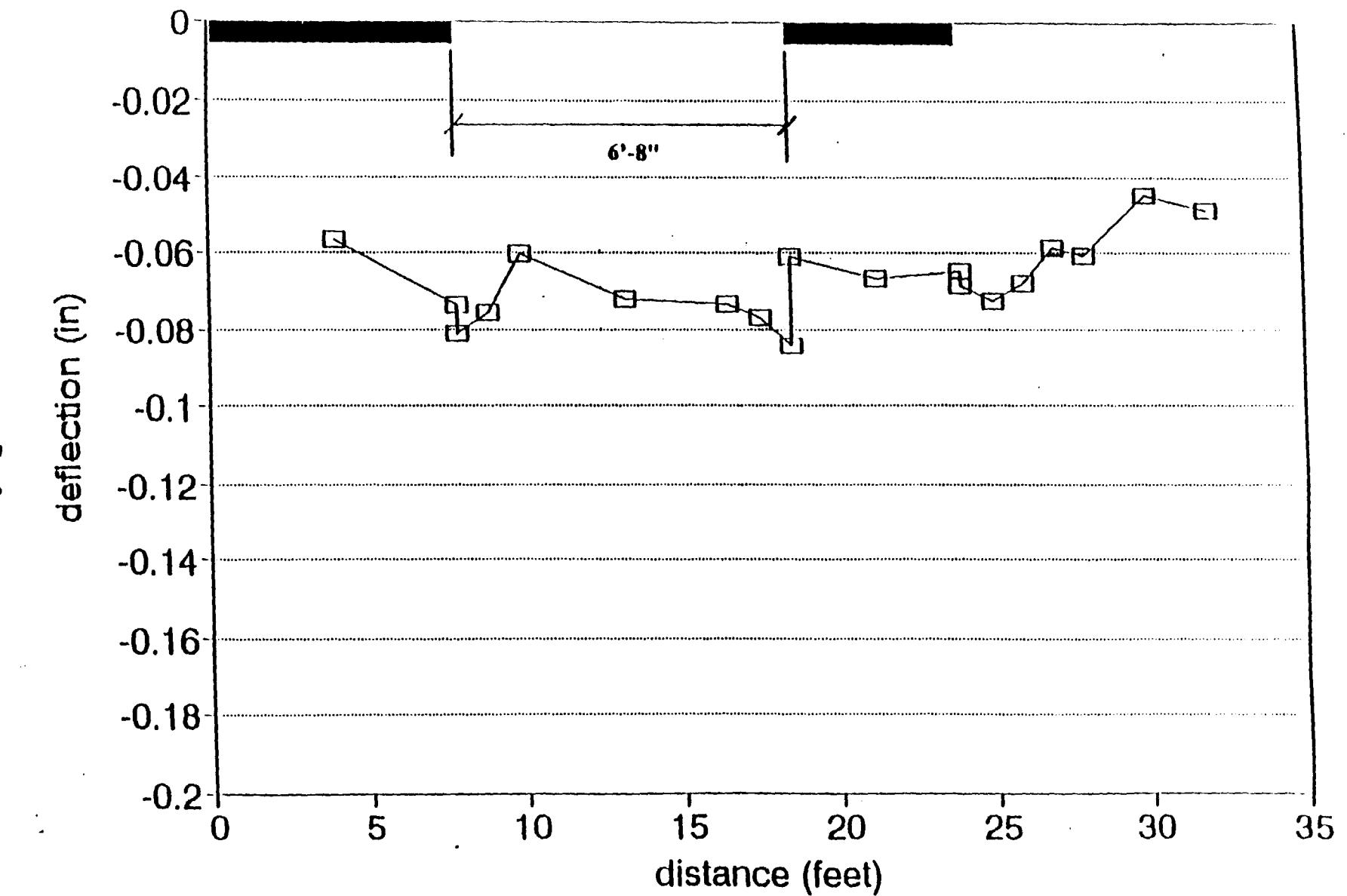
Utility Cut Description	Traffic	Load (kips)	Test Point Location	FWD Deflection (in.)	Benkelman Beam Deflection (in.)
UCASPPRK2324	L	12	cut edge, pvmt.	0.0324897	0.077
			1' from edge	0.0348318	0.067
			2' from edge	0.0348318	0.058
			4' from edge	0.029859	0.06
			control	0.0239316	0.054
UCASPFFD3054	L	12	cut edge, pvmt.	0.0384468	0.037
			1' from edge	0.0473179	0.05
			2' from edge	0.051842	0.046
			4' from edge	0.0559153	0.044
			control	0.0438403	0.047
UCASPROC1005	L	12	cut edge, pvmt.	0.1337427	0.128
			1' from edge	0.1255317	0.137
			2' from edge	0.1151633	0.14
			4' from edge	0.1060507	0.114
			control	0.1079505	0.119
UCMACDUN3422	L	12	cut edge, pvmt.	0.1132335	0.131
			1' from edge	0.12276	0.135
			2' from edge	0.131145	0.147
			4' from edge	0.113775	0.127
			control	0.11304	0.13
UCMACMON3431	L	12	cut edge, pvmt.	0.12057	0.103
			1' from edge	0.128145	0.13
			2' from edge	0.121425	0.112
			4' from edge	0.110595	0.114
			control	0.097515	0.111
UCMACMON3579	L	12	cut edge, pvmt.	0.076185	0.055
			1' from edge	0.074955	0.071
			2' from edge	0.068475	0.064
			4' from edge	0.063765	0.072
			control	0.072945	0.091

TABLE B.4. Correlation Between FWD-15 kip and Benkelman Beam Deflections

Utility Cut	Traffic	Load (kips)	Test Point Location	FWD Deflection (in.)	Benkelman Beam Deflection (in.)
UCASPCLIHUC	H	15	cut edge, pvmnt.	0.02091	0.018
			1' from edge	0.017115	0.017
			2' from edge	0.0132	0.013
			4' from edge	0.01131	0.011
			control	0.01596	0.012
UCASPLIN859	M	15	cut edge, pvmnt.	0.067821	0.143
			1' from edge	0.0597624	0.117
			2' from edge	0.0531135	0.091
			4' from edge	0.0613941	0.086
			control	0.058275	0.087
UCASP8TH304S	M	15	cut edge, pvmnt.	0.03033	0.024
			1' from edge	0.032655	0.029
			2' from edge	0.033315	0.036
			4' from edge	0.03711	0.032
			control	0.04059	0.026
UCMACOBS2881	M	15	cut edge, pvmnt.	0.04695	0.042
			1' from edge	0.03852	0.028
			2' from edge	0.034305	0.025
			4' from edge	0.03228	0.025
			control	0.03582	0.024
UCMACOBS3044	M	15	cut edge, pvmnt.	0.04152	0.049
			1' from edge	0.039375	0.051
			2' from edge	0.034845	0.046
			4' from edge	0.03405	0.045
			control	0.039315	0.048
UCMACLAF402	M	15	cut edge, pvmnt.	0.0565776	0.058
			1' from edge	0.0518256	0.062
			2' from edge	0.0481824	0.057
			4' from edge	0.0476064	0.051
			control	0.0210672	0.021
UCMACWTF3332	M	15	cut edge, pvmnt.	0.0536976	0.033
			1' from edge	0.0507168	0.037
			2' from edge	0.0478368	0.039
			4' from edge	0.0524736	0.035
			control	0.0483696	0.032

TABLE B.4. (Contd)

Utility Cut Description	Traffic	Load (kips)	Test Point Location	FWD Deflection (in.)	Benkeiman Deflection (in.)
UCASPPRK2324	L	15	cut edge, pvmL 1' from edge 2' from edge 4' from edge control	0.0411699 0.0466422 0.0422133 0.039405 0.030081	0.077 0.067 0.058 0.06 0.054
UCASPFFD3054	L	15	cut edge, pvmL 1' from edge 2' from edge 4' from edge control	0.048622 0.0570906 0.0644483 0.0714035 0.0570262	0.037 0.05 0.046 0.044 0.047
UCASPROC1005	L	15	cut edge, pvmL 1' from edge 2' from edge 4' from edge control	0.1746206 0.1529661 0.145544 0.1330826 0.1367534	0.128 0.137 0.14 0.114 0.119
UCMACDUN3422	L	15	cut edge, pvmL 1' from edge 2' from edge 4' from edge control	0.142215 0.139515 0.143925 0.147345 0.14532	0.131 0.135 0.147 0.127 0.13
UCMACMON3431	L	15	cut edge, pvmL 1' from edge 2' from edge 4' from edge control	0.14685 0.137685 0.14508 0.136395 0.122895	0.103 0.13 0.112 0.114 0.111
UCMACMON3579	L	15	cut edge, pvmL 1' from edge 2' from edge 4' from edge control	0.09624 0.092505 0.086085 0.079965 0.09195	0.055 0.071 0.064 0.072 0.091



**FIG. B.1. Deflections between Multiple Cuts at Intersection
between Reading and Forest .**

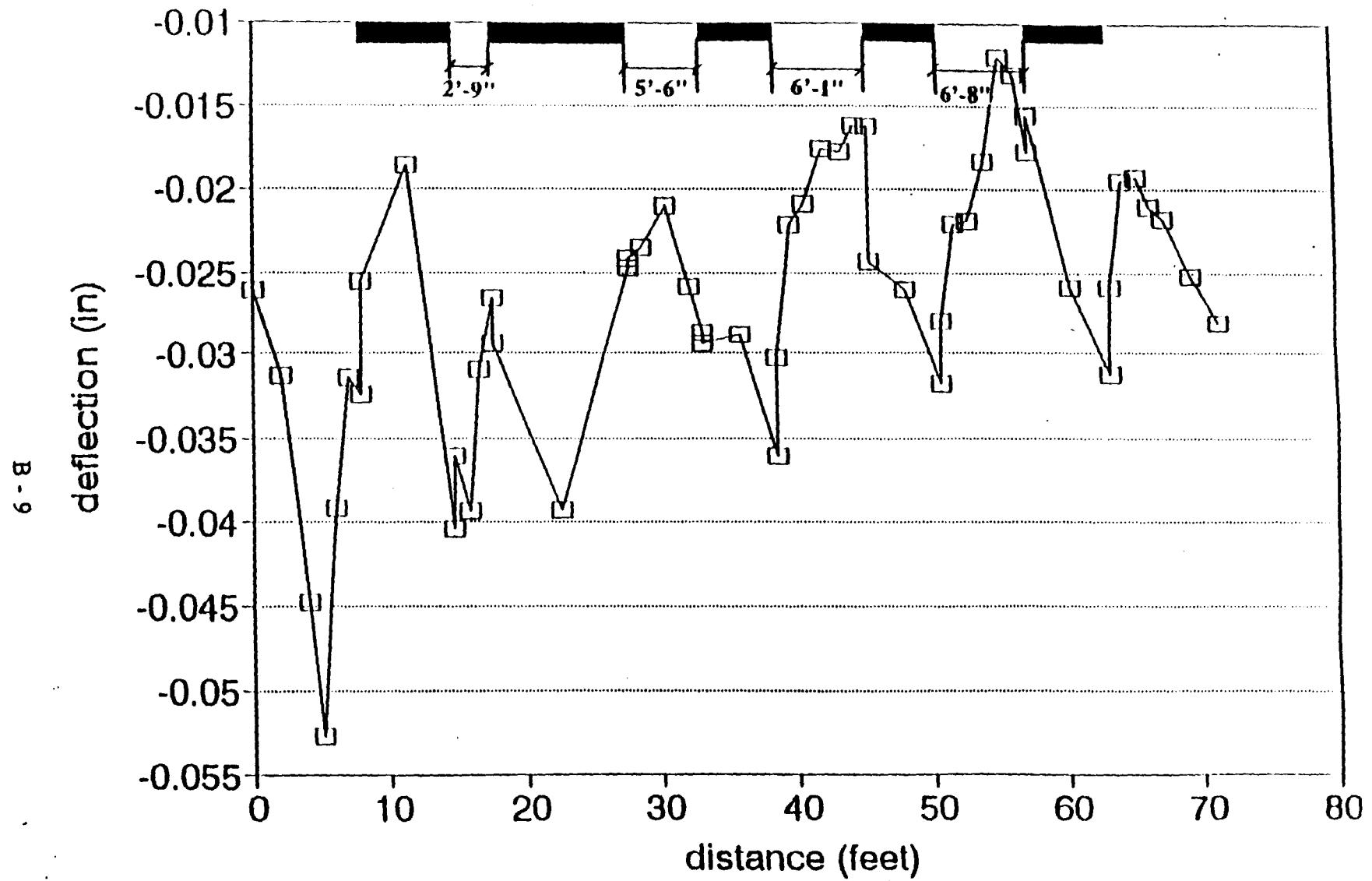


FIG. B.2. Deflections between Multiple Cuts at 3161 Reading

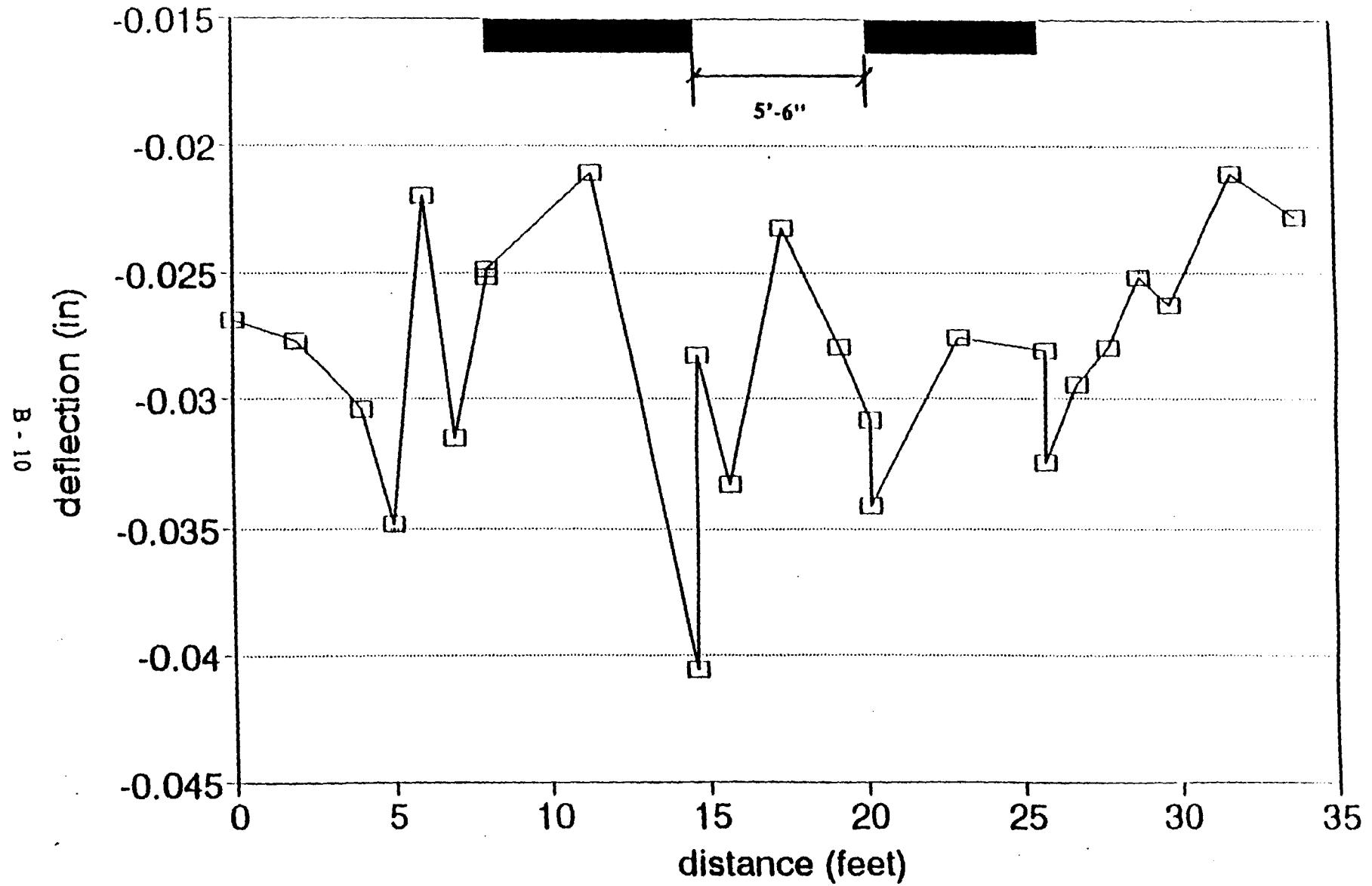


FIG. B.3. Deflections between Multiple Cuts at 3215 Madison

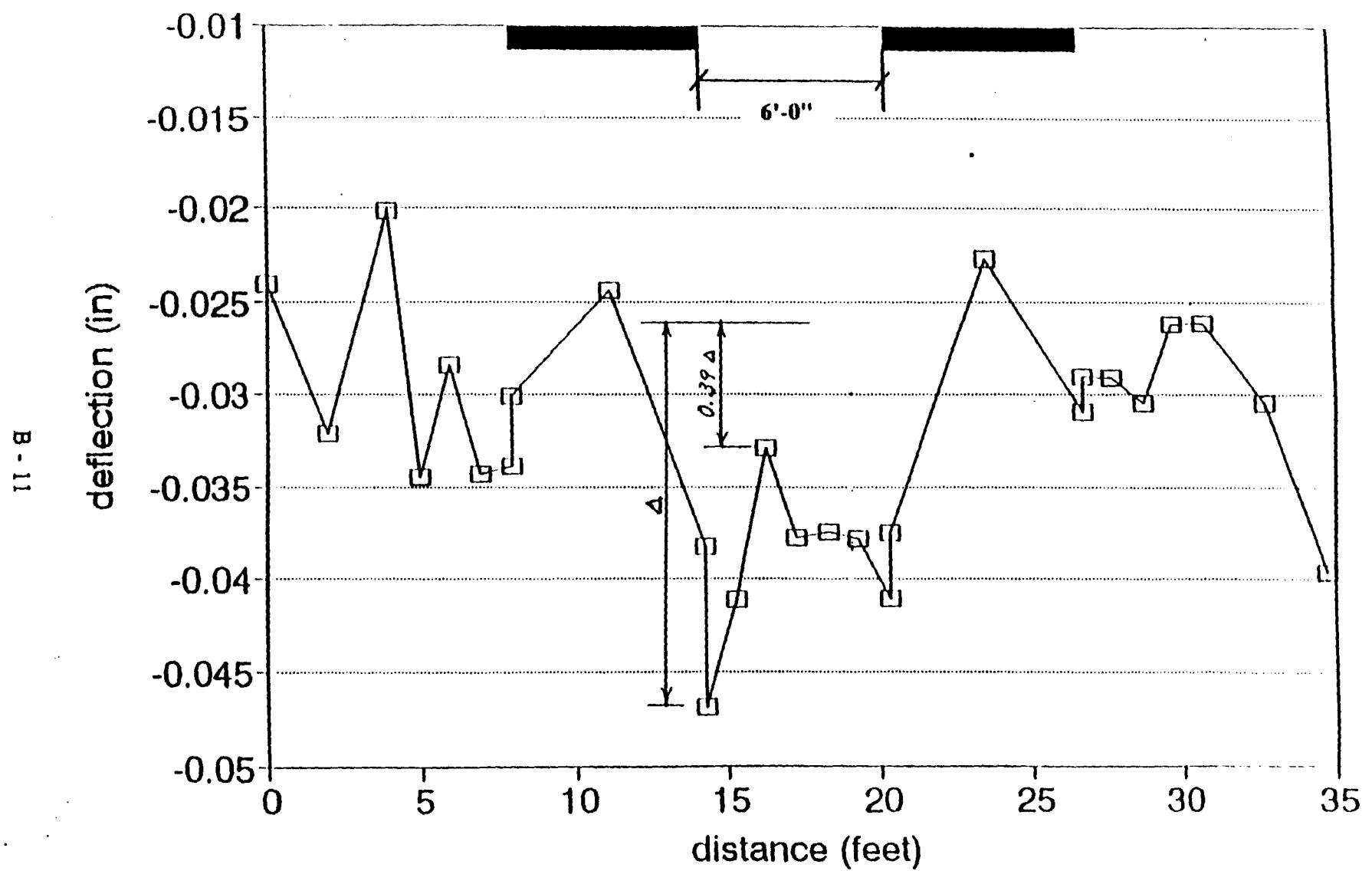


FIG. B.4. Deflections between Multiple Cuts at 2741 Observatory

B - 12

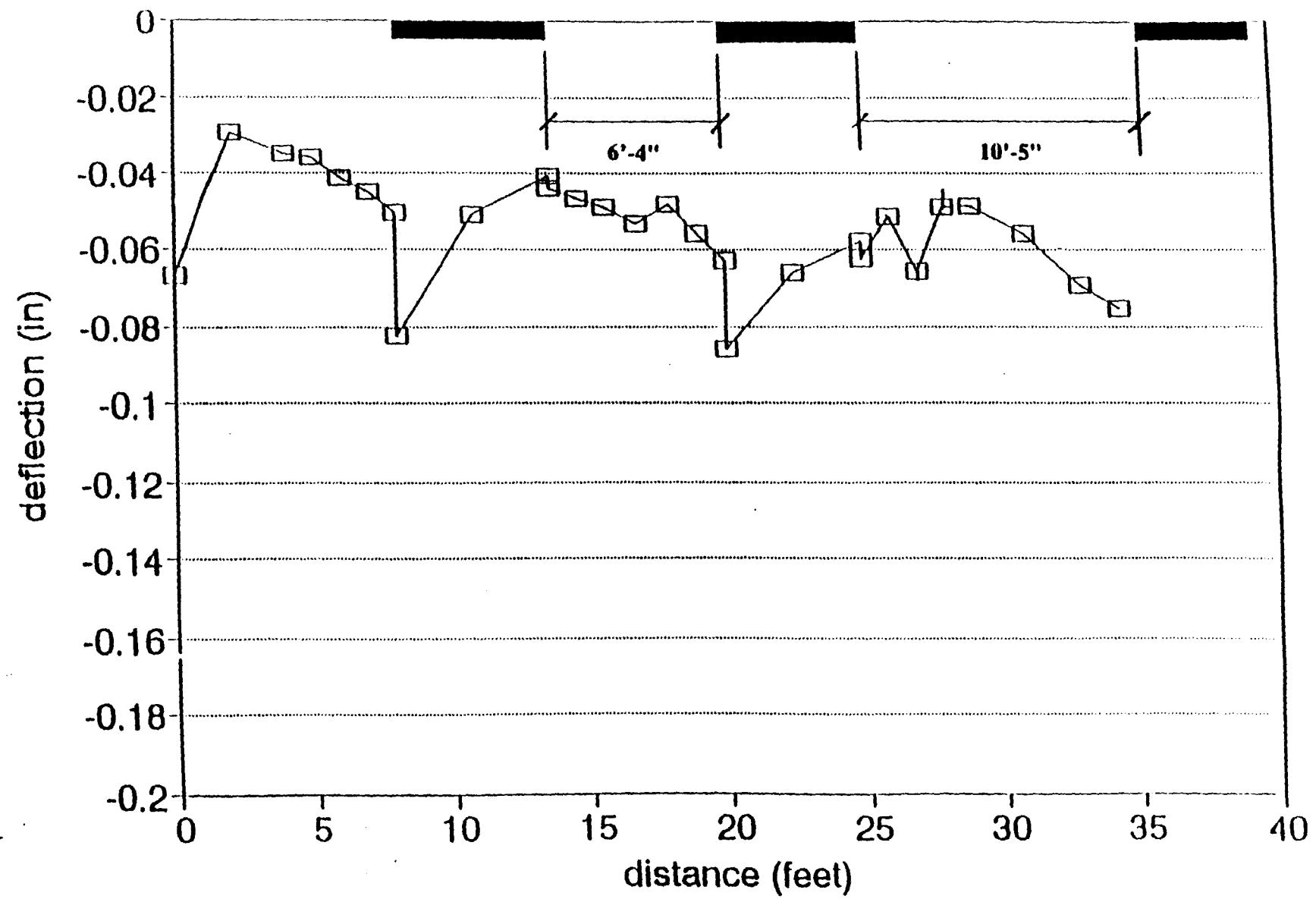


FIG. B.5. Deflections between Multiple Cuts at 2724 Madison

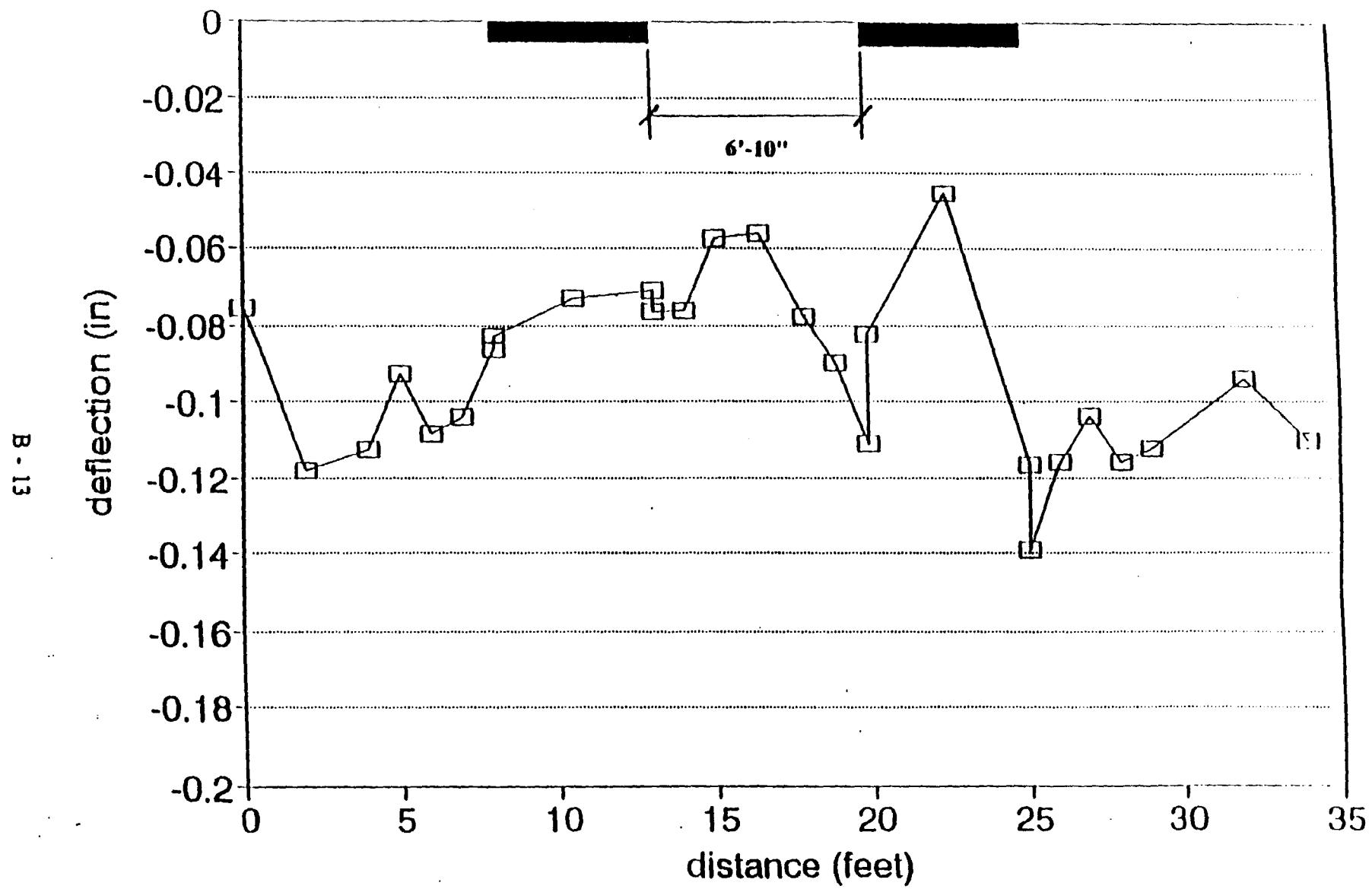


FIG. B.6. Deflections between Multiple Cuts at 2723 Markbreit

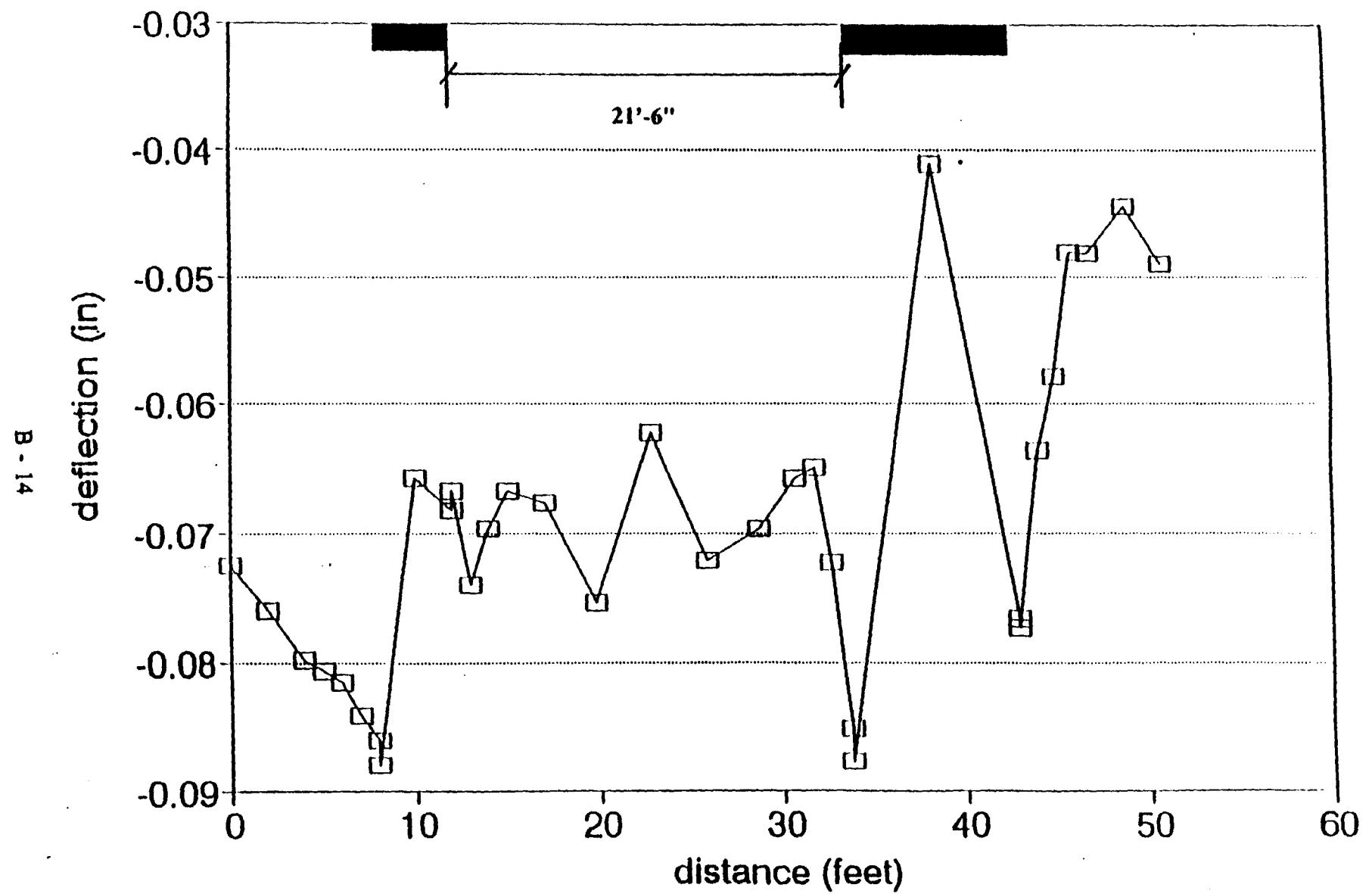


FIG. B.7. Deflections between Multiple Cuts at 2901 Markbreit

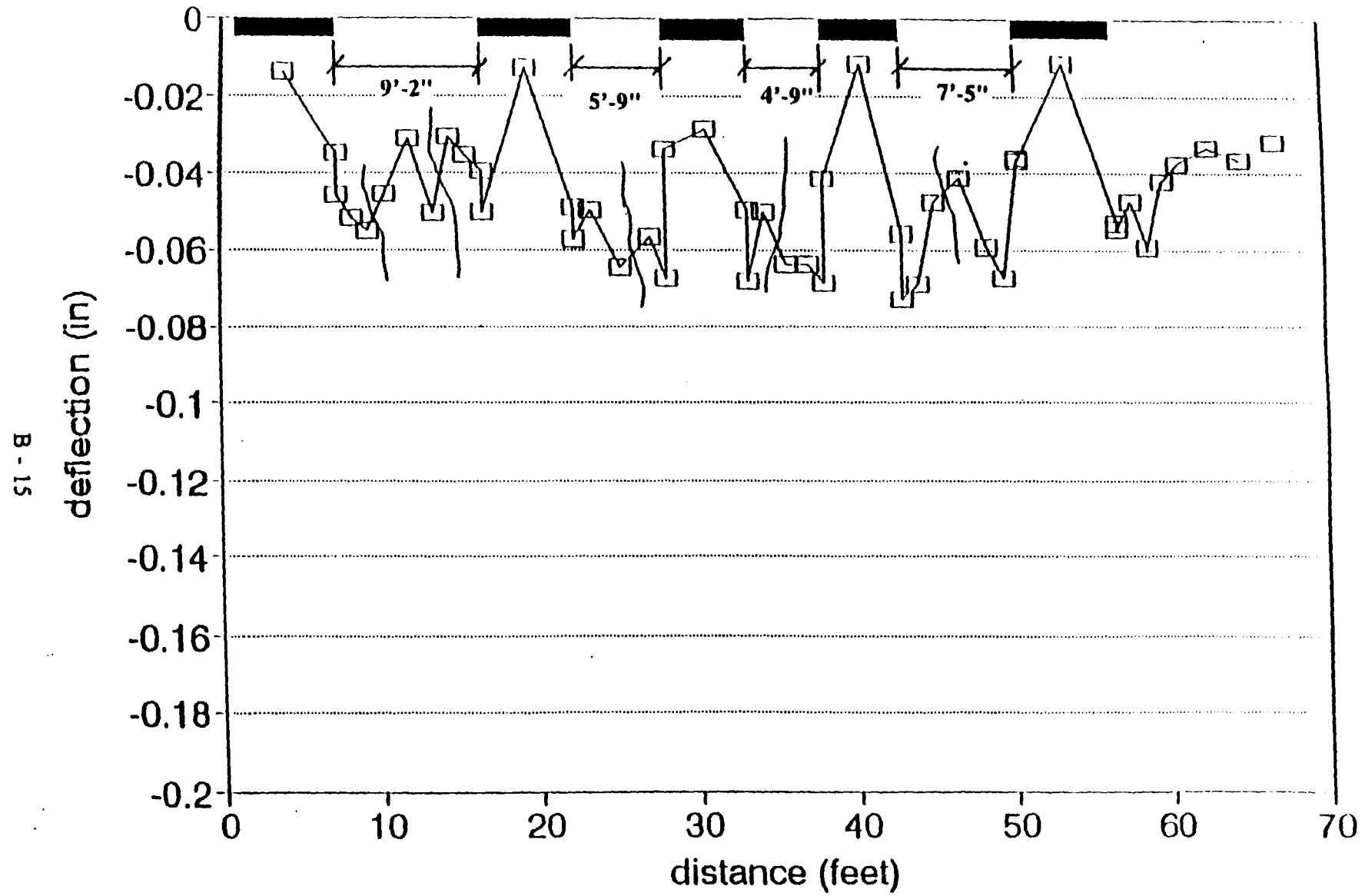


FIG. B.8. Deflections between Multiple Cuts at 3016 Euclid

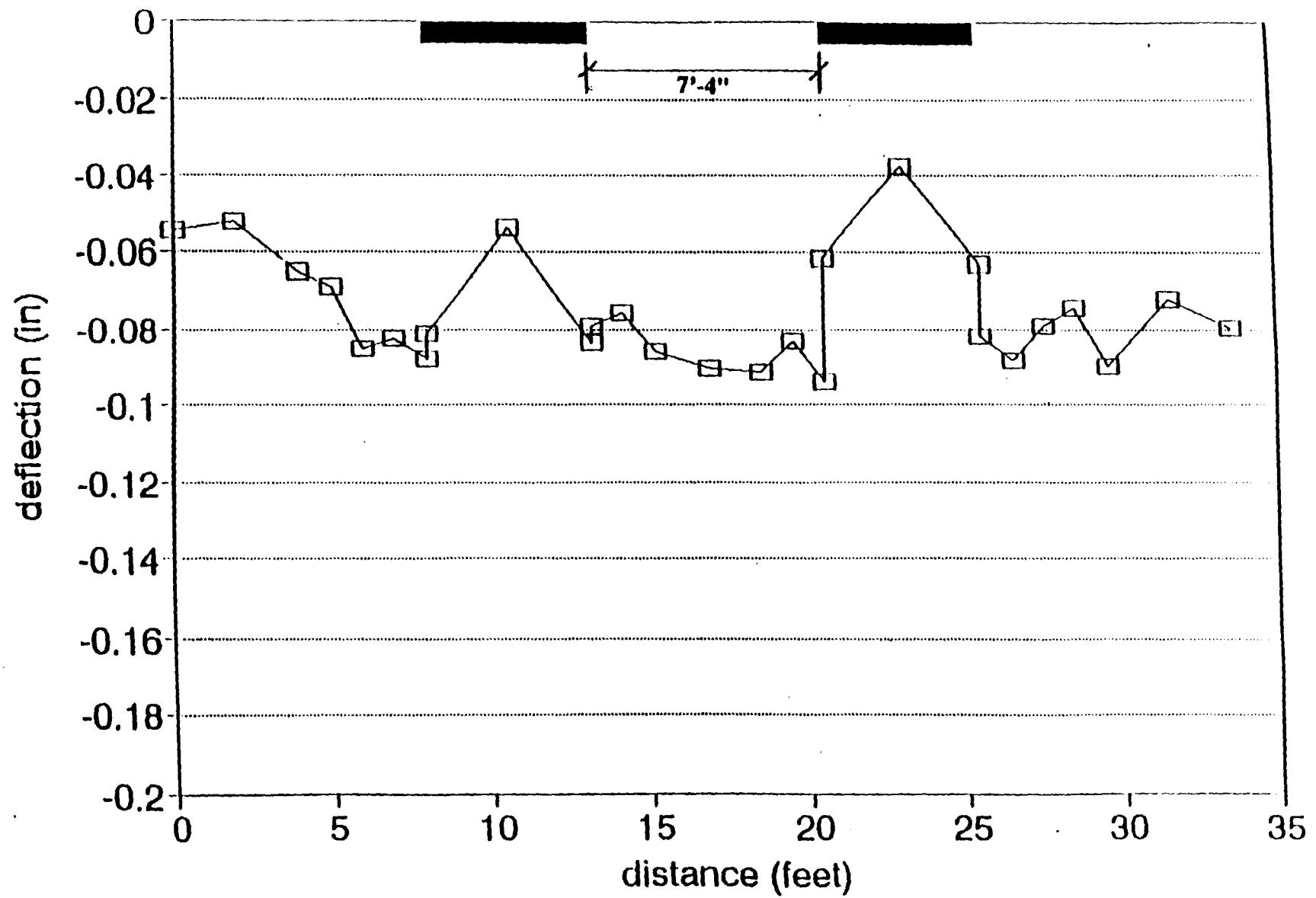


FIG. B.9. Deflections between Multiple Cuts at 3357 Woodford

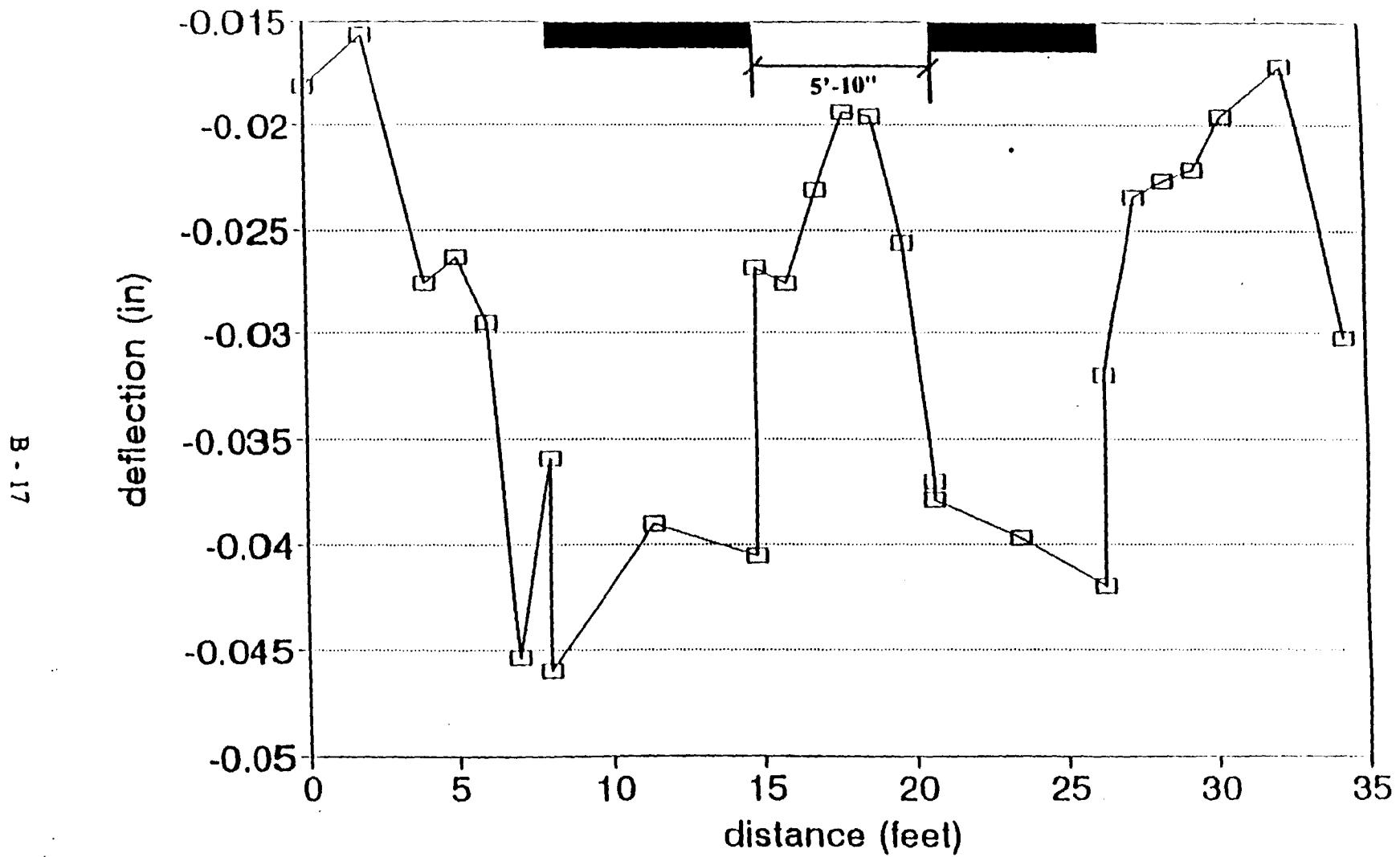


FIG. B.10. Deflections between Multiple Cuts at 822 Seton

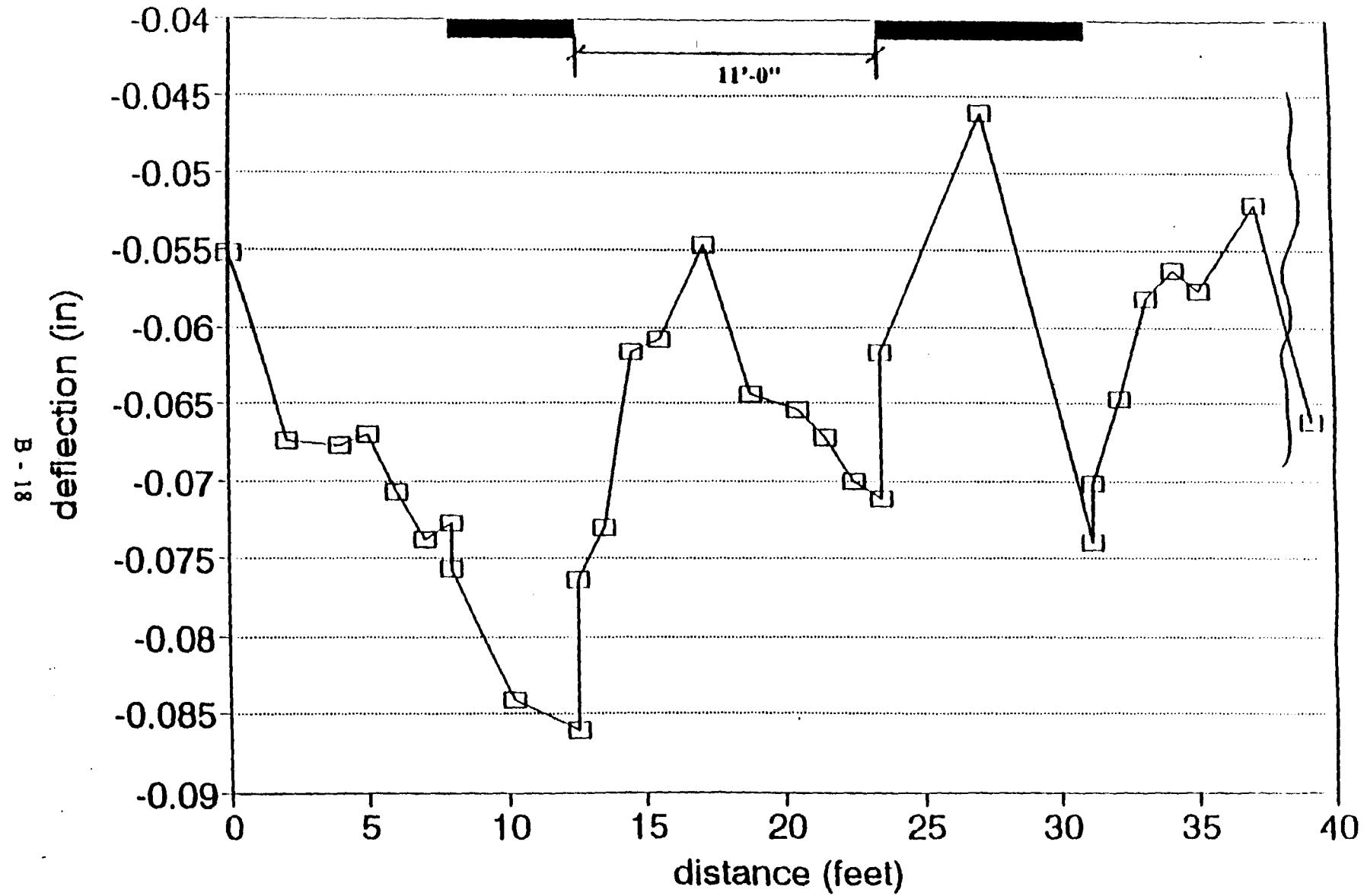


FIG. B.11. Deflections between Multiple Cuts at 321 Helen

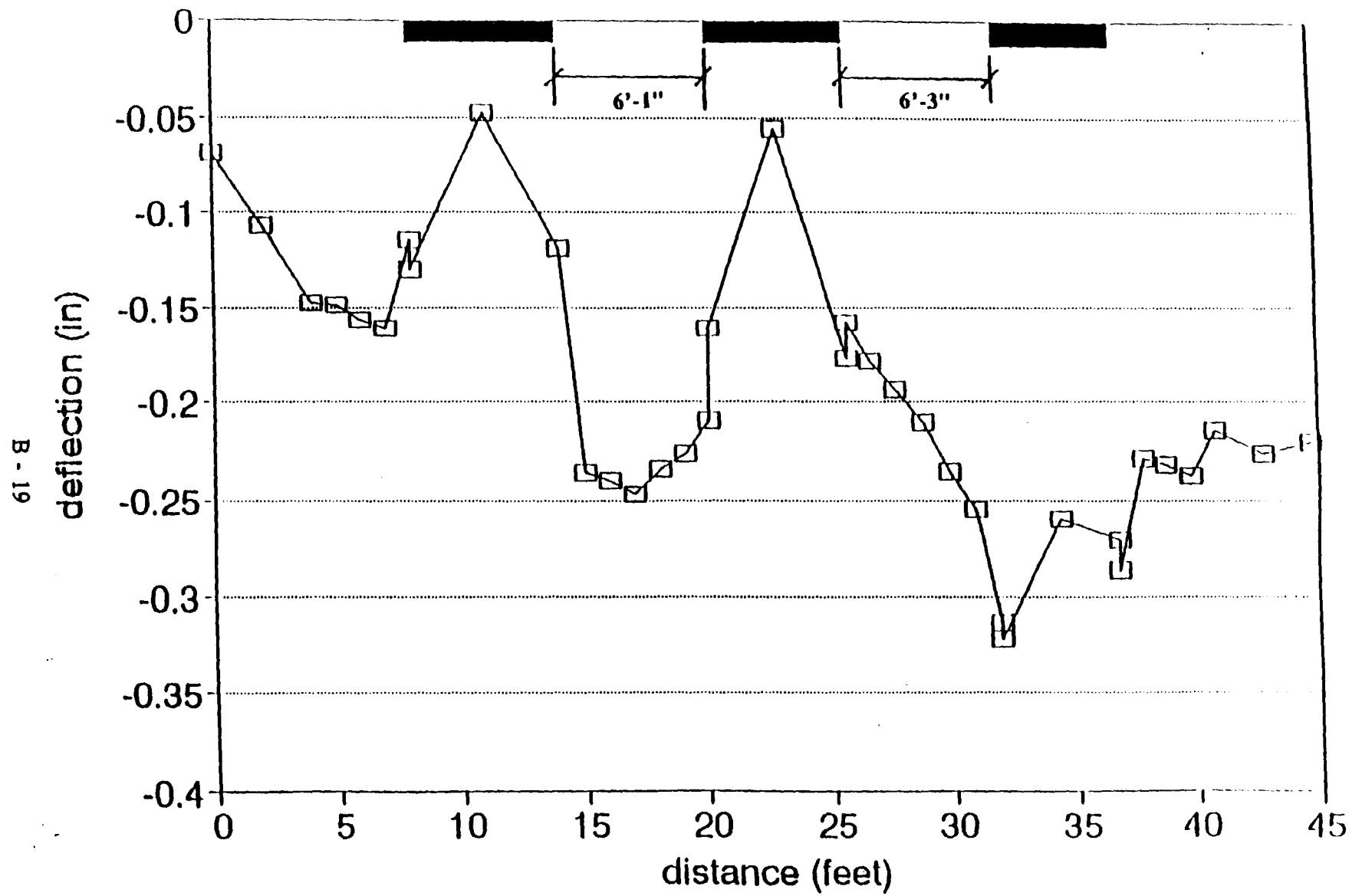


FIG. B.12. Deflections between Multiple Cuts at 346 Terrace

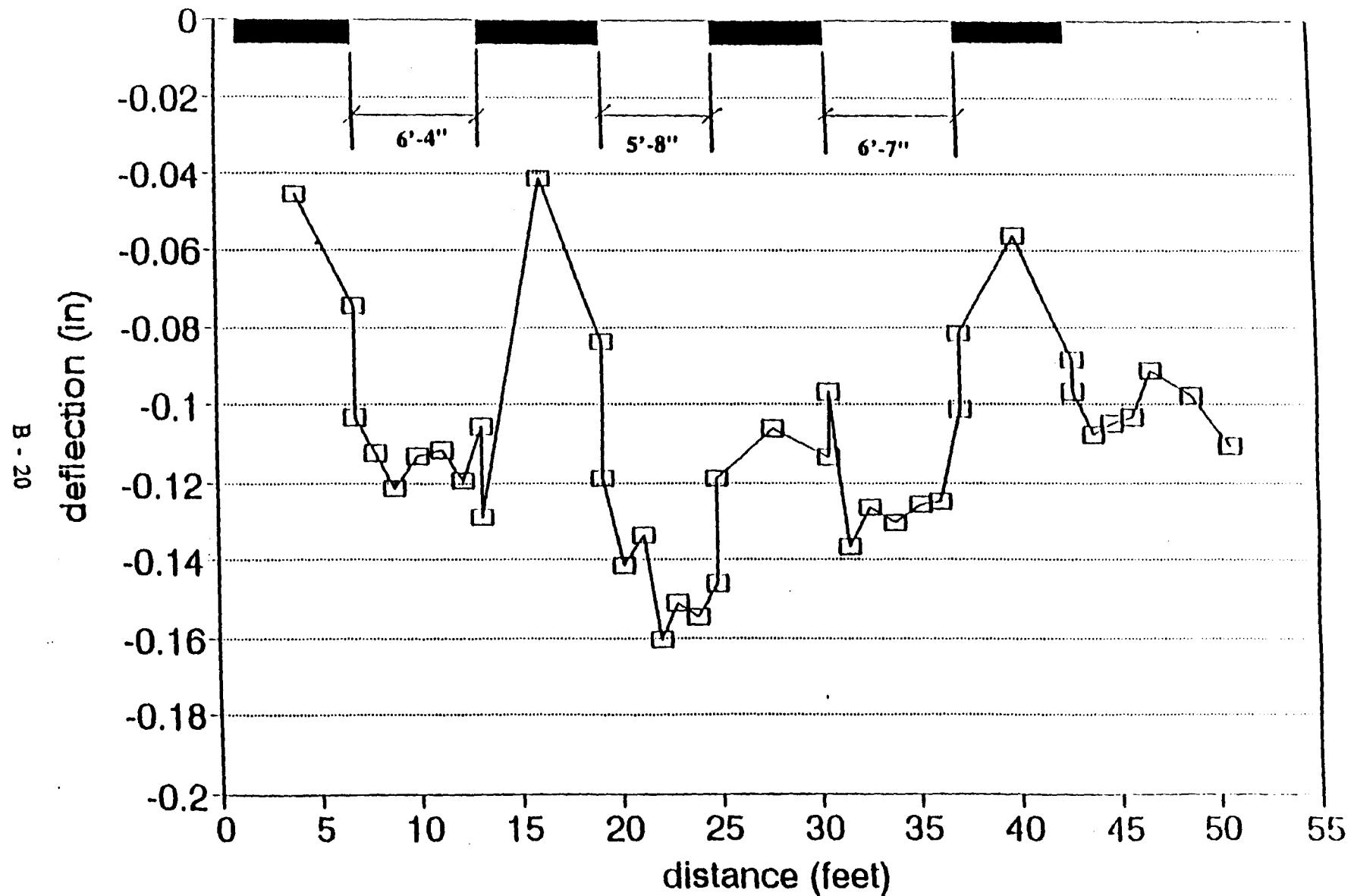


FIG. B.13. Deflections between Multiple Cuts at 3228 Harvest

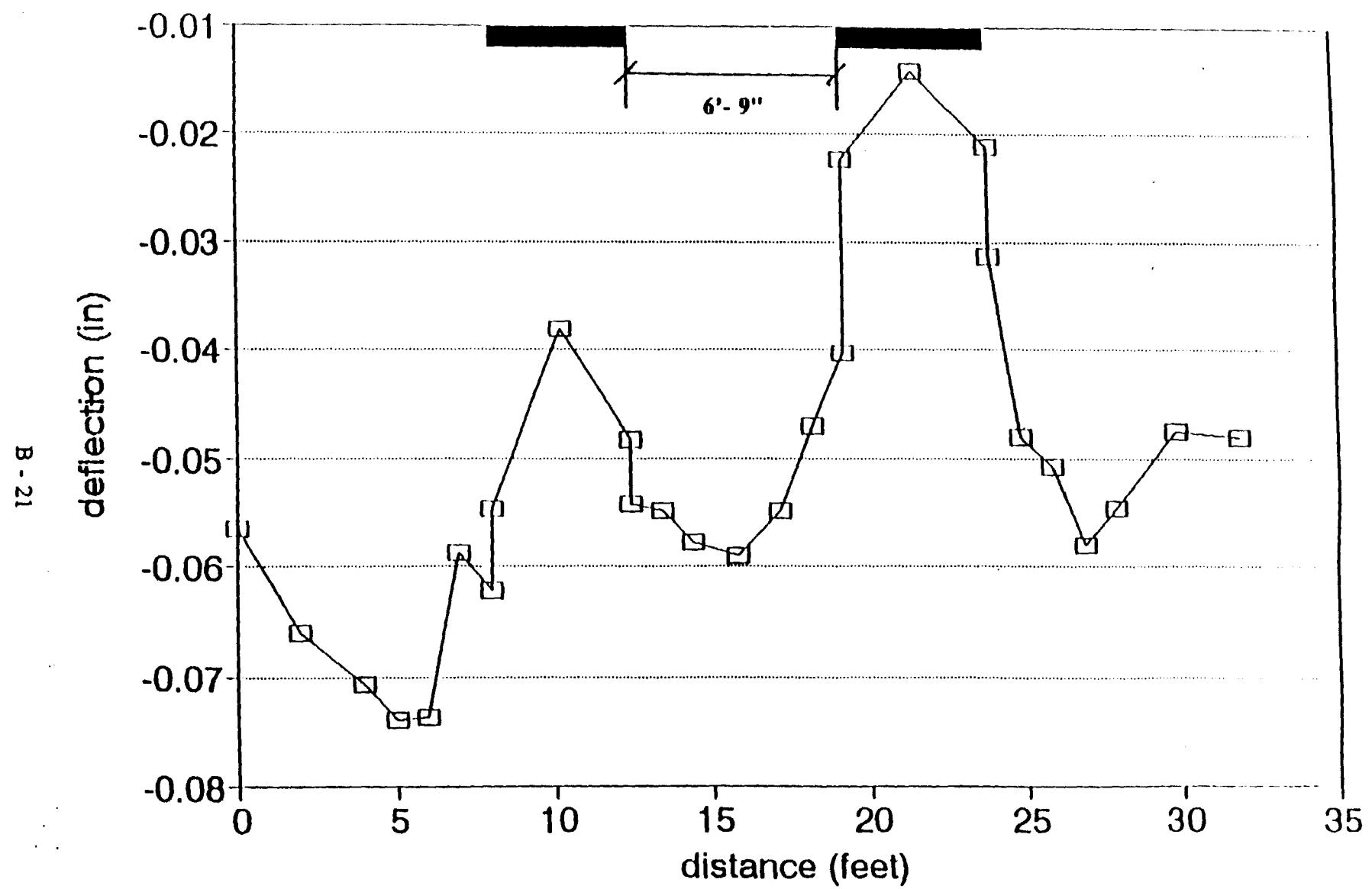


FIG. B.14. Deflections between Multiple Cuts at 3648 Michigan

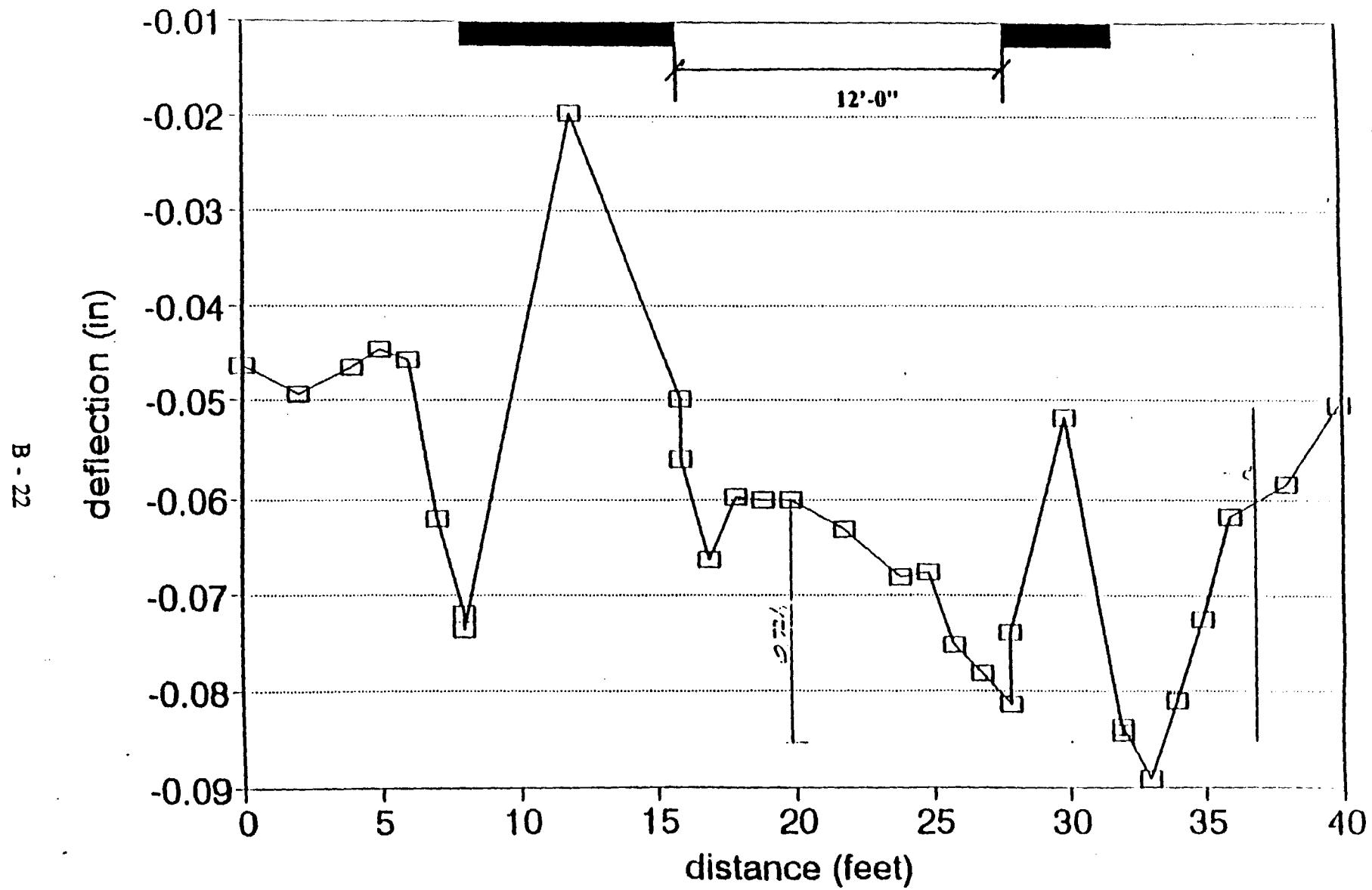
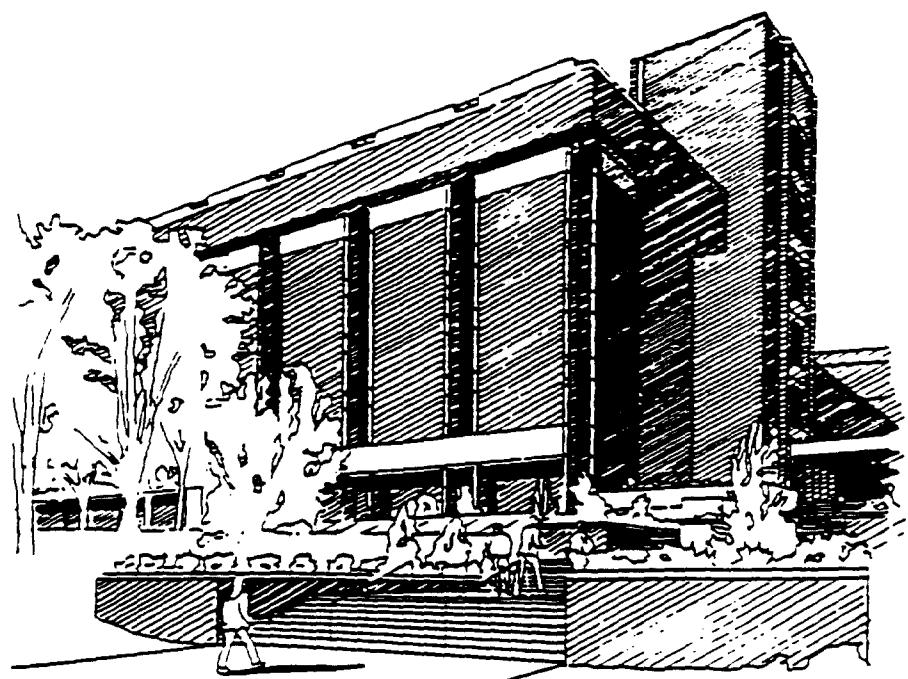


FIG. B.15. Deflections between Multiple Cuts at 3363 Morrison

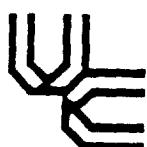
APPENDIX C



UNIVERSITY OF CINCINNATI
COLLEGE OF ENGINEERING

**Distress Identification Manual for
Utility Cuts**

Cincinnati Infrastructure Institute
Department of Civil and
Environmental Engineering



**Distress Identification Manual
for Utility Cuts**

**Cincinnati Infrastructure Institute
Department of Civil and
Environmental Engineering**

**University of Cincinnati
November, 1991**

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Background

Several manuals have been developed for identification of distresses on pavements. Generally these manuals, for various types of pavements, present distresses commonly observed, their severity, extent and method of measurement. Engineers have the option to adopt one of the existing manuals for the distress survey with modifications, if necessary. A survey thus carried out presents the condition of pavements on an extended section of a highway at a global level. But, when the distresses are localized, a micro level investigation would be imminent. The city engineers are often confronted with this situation because of the utility cuts, the size of which usually range from 15 sq. ft to 50 sq. ft. Since the influenced area in and around the utility cut is very small in comparison with the extended pavement section, it is obvious that a micro level investigation of the distress mechanism would be in order. Unfortunately, the manuals currently available do not make a clear distinction between the evaluation of extended pavement section and utility cuts. The research team currently involved in the evaluation of distresses in and around utility cuts, after a thorough review of the manuals available, realize the need for specific guidelines for utility cuts. Several new distresses not addressed in those manuals have been noticed by the researchers. Also it is believed that only the severity of distress, and not the extent, is relevant in view of the relatively small area of utility cuts.

This manual is a first attempt to list the predominantly present distresses in utility cuts. In all, nine types of distresses have been listed. Since these are found to be independent of the type of pavement, it is suggested that the same set of distresses be used irrespective of the type of pavement. A revision of this manual is anticipated in the future.

City Cincinnati

Prepared by: _____

Date of Survey: _____

Location: _____

Time of Survey: _____

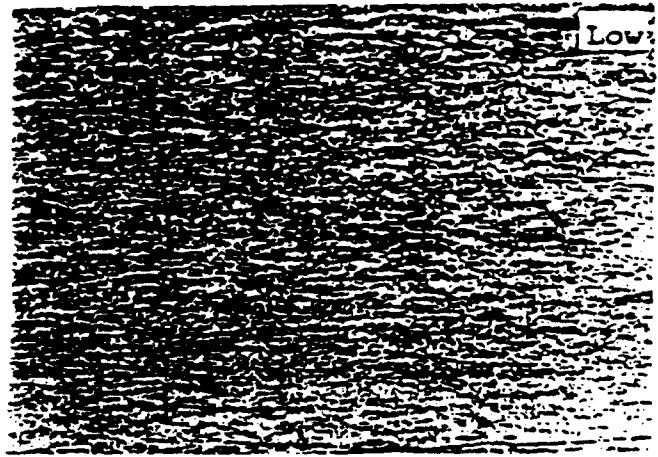
Surface Profile (enter a number)	very poor	poor	fair	good	excellent		
	0 - 20	21 - 40	41 - 60	61 - 80	81 - 100		
Distresses <small>(Rate by severity. If different levels exist, rate by highest severity)</small>	Cut			Vicinity		Any additional distress? Overall condition <input type="checkbox"/> very poor(0-20) <input type="checkbox"/> poor(21-40) <input type="checkbox"/> fair(41-60) <input type="checkbox"/> good(61-80) <input type="checkbox"/> excellent(81-100)	
Alligator Cracking	low	moderate	high	low	moderate		high
Edge Cracking							
Transverse Cracking							
Potholes							
Rutting							
Ravelling & Weathering							
Cut-to-Adjacent Pavement Drop-off							
Edge Separation							
Corner Breaks							
Additional Remarks:							

Alligator Cracking: Series of interconnected cracks, chicken wire/alligator pattern

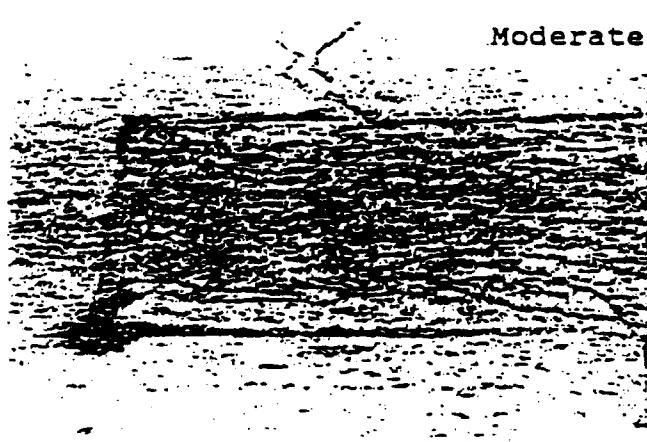
Cause: Repeated traffic loading, base course saturation

Severity Levels

Low: Fine, longitudinal disconnected, unspalled hair line cracks running parallel to each other



Moderate



Moderate: Development of light alligator cracks into a network of cracks that may be lightly spalled

High: Cracks severely spalled at the edges, loosened pieces rock under traffic

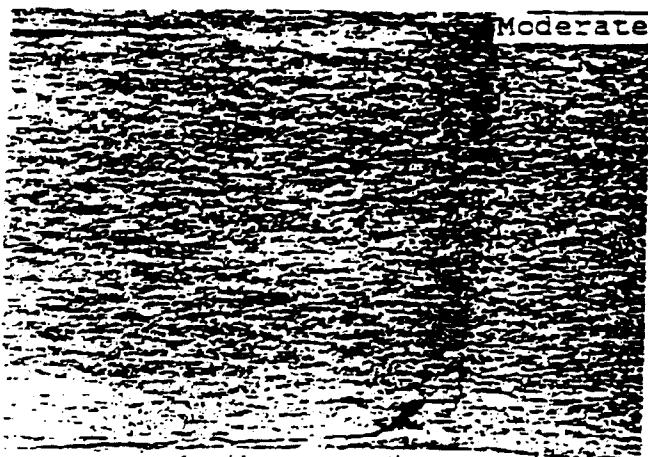


Edge Cracking: Parallel to and within 6 inches of the edge

Cause: Weak base or subgrade

Severity Levels

Low: Cracking with no break up or ravelling



Moderate: Cracking with some break up or ravelling

High: Considerable break up or ravelling along the edge

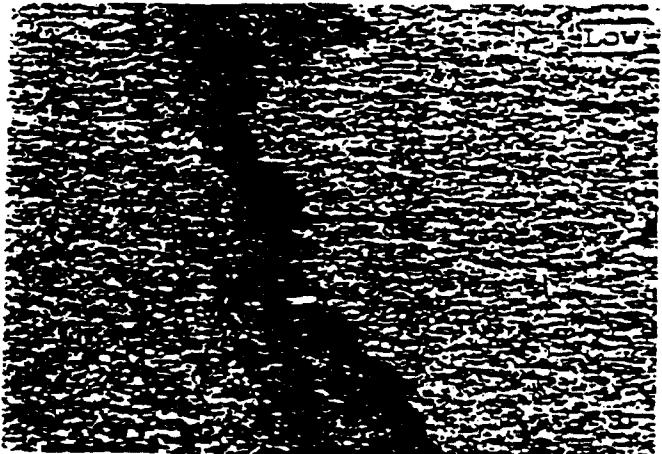


Transverse Cracking: Cracks running across the pavement

Cause: Shrinkage due to low temperature; hardening of asphalt

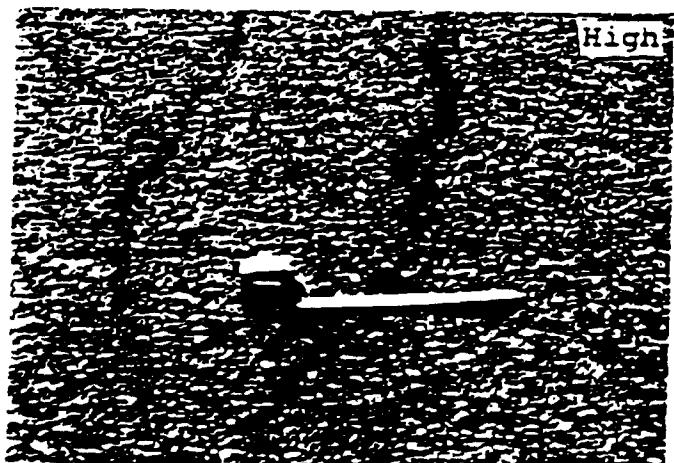
Severity Levels

Low: Crack width less than 1/4";
no spalling



Moderate: Crack width 1/4" to
3/4"; moderate spalling

High: Crack width greater than
3/4"; spalled cracks



Potholes: Bowl shaped depressions

Cause: Loss of material, poor surface mixture, weak spots in the base or subgrade, high severity alligator cracking

Severity Levels

Low: Maximum depth up to 1"



Moderate



Moderate: Maximum depth 1" to 2"

High: Maximum depth greater than 2"



Rutting: Longitudinal surface depression

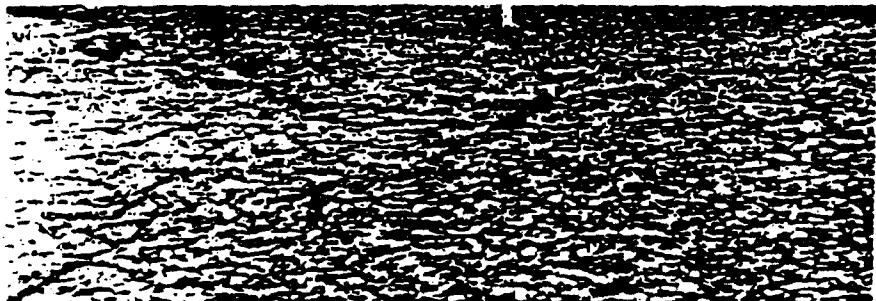
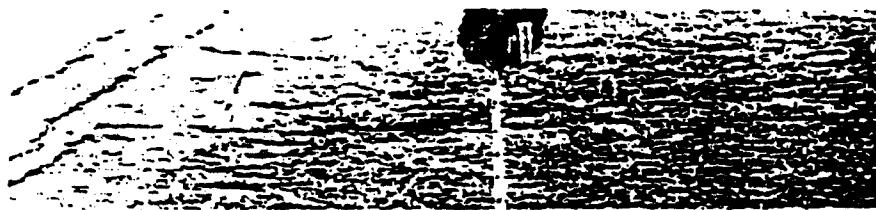
Cause: Permanent deformation of pavement layers or subgrade due to traffic load

Severity Levels

Low: Mean rut depth up to $1/4"$

Moderate: Mean rut depth $1/4"$ to $3/4"$

High: Mean rut depth greater than $3/4"$

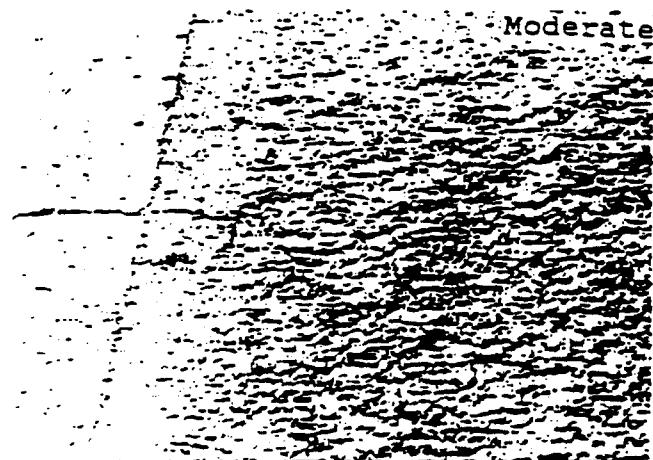
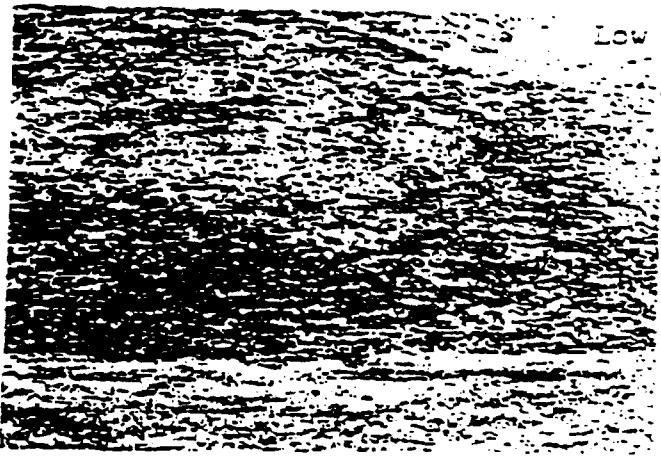


Ravelling and Weathering: Wearing away of the surface due to loss of asphalt and dislodged aggregate particles

Cause: Softening of the surface; oil spillage

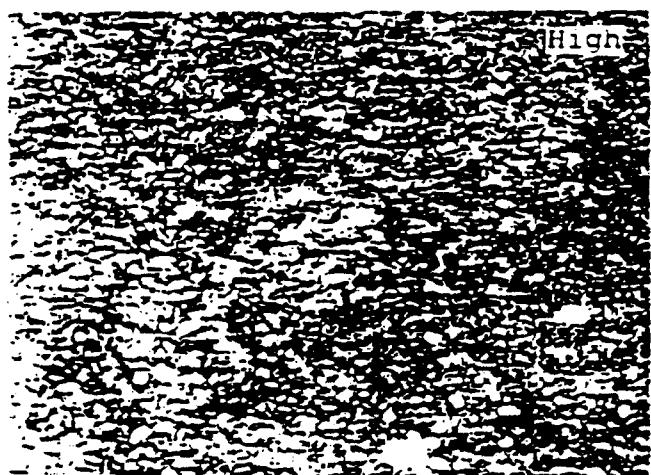
Severity Levels

Low: Aggregate or binder started to wear away; surface started to pit



High: Aggregate or binder worn away considerably; surface texture very rough and severely pitted

Moderate: Aggregate or binder worn away; surface texture moderately rough and pitted

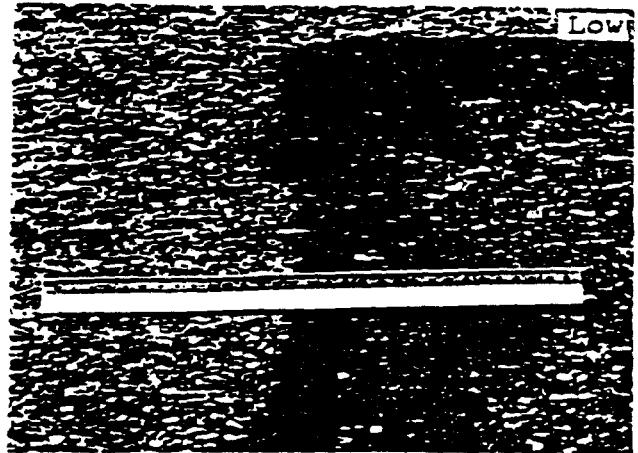


Cut-to-Adjacent Pavement Drop-Off: Difference between the utility cut and the adjacent pavement near the edges

Cause: Settlement of the cut, inadequate compaction, improper construction, inferior material

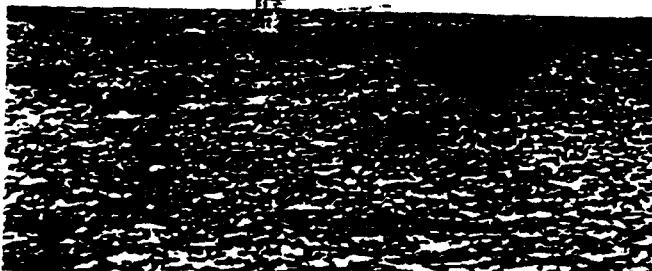
Severity Level

Low: Difference in elevation up to 1/2"

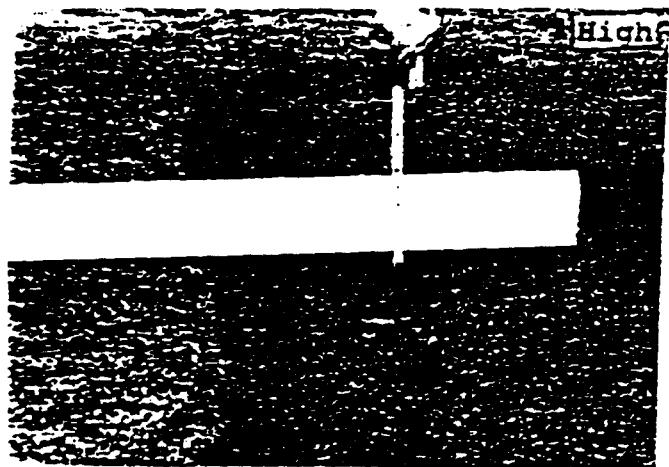


Moderate

Moderate: Difference in elevation 1/2" to 1"



High: Difference in elevation greater than 1"

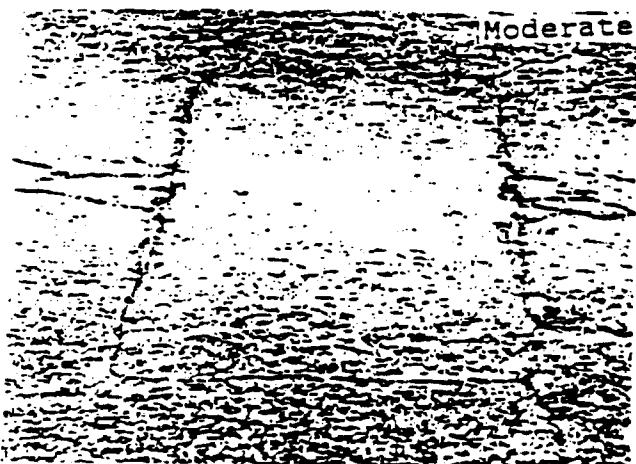
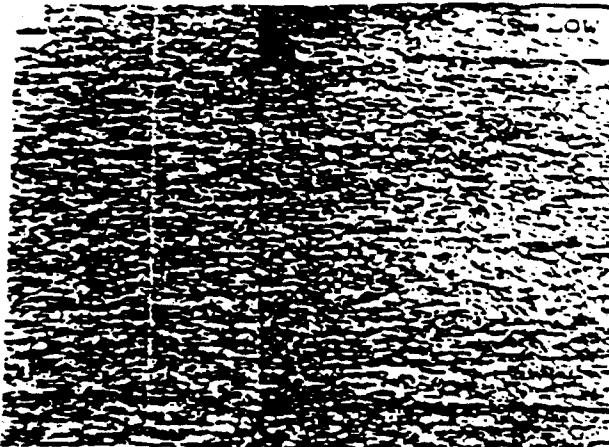


Edge Separation: Utility cut separated from the adjacent pavement section

Cause: Inadequate bond, faulty construction, use of inferior material

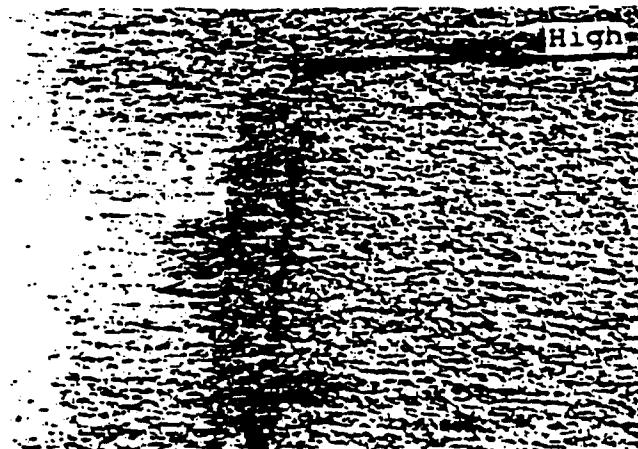
Severity Level

Low: Gap up to 1/4"



Moderate: Gap 1/4" to 1/2"

High: Gap greater than 1/2"

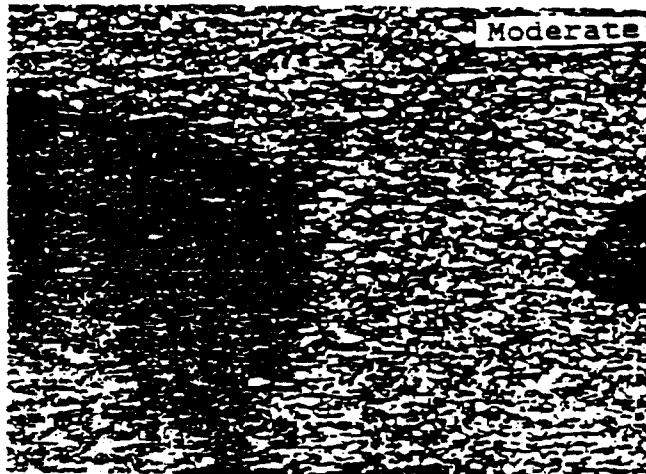
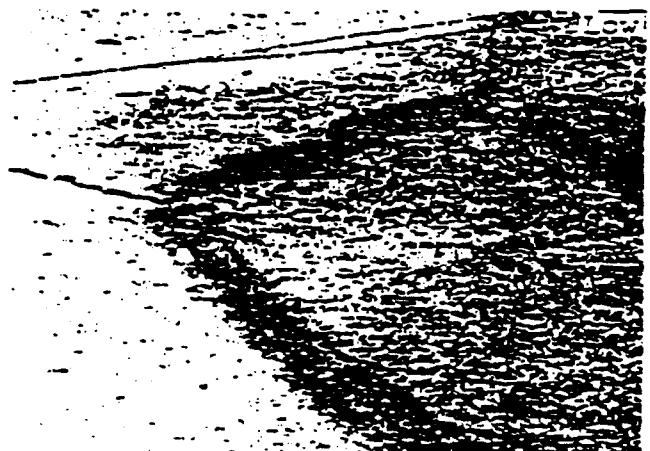


Corner Breaks: Crack at corner of slab that intersects the joints less than 6" from the corner on each side

Cause: Heavy repeated loads combined with poor load transfer and inadequate drainage

Severity Level

Low: Crack well sealed; no faulting or break-up



Moderate: Slightly broken; faulting of crack or joint less than 1/2"

High: Badly broken at the corner into two or more pieces: Faulting of crack or joint greater than 1/2"

